AVIATION

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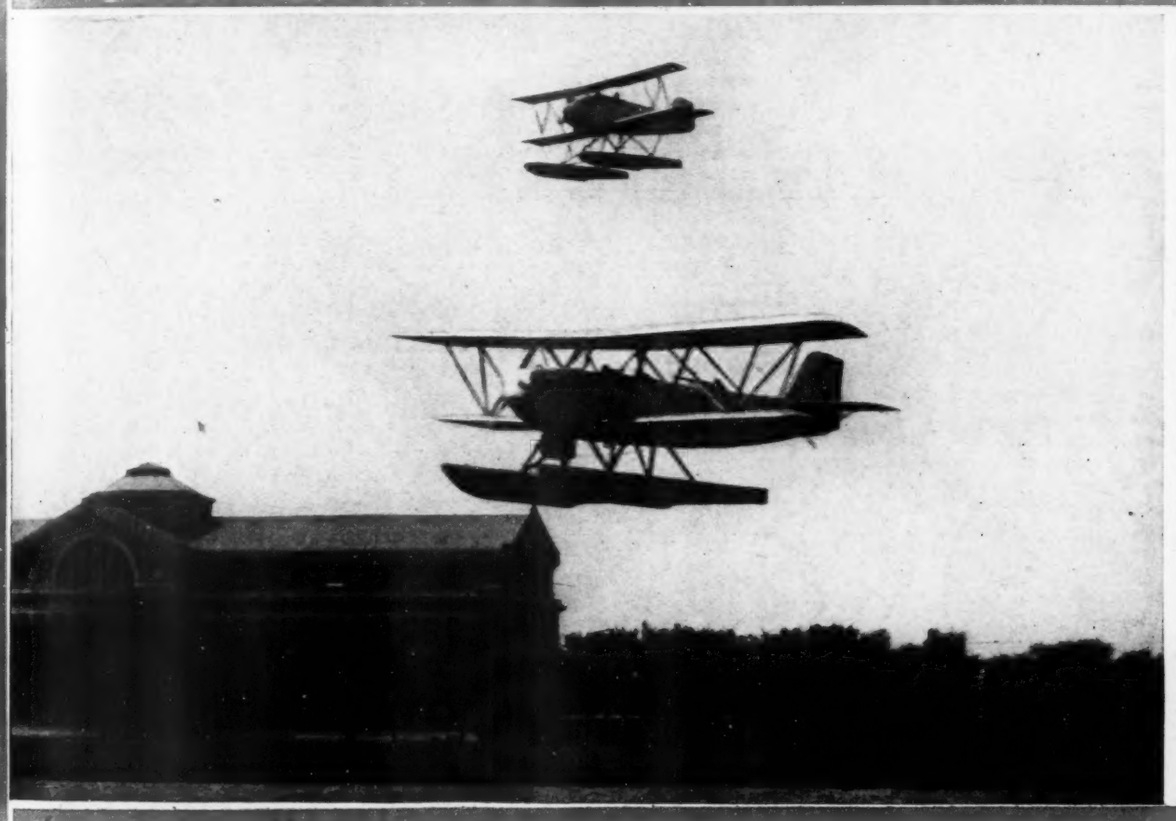

Cox-Klemin submarine plane (top) and Glenn Martin observation plane flying over the War College

Photo International

VOLUME XV

NUMBER 18

SPECIAL FEATURES

NEW ARCTIC FLYING EXPEDITION

GLIDING THEORY AND GLIDER OPERATION

AEROMARINE METAL HULL FLYING BOAT

THE GARDNER, MOFFAT CO., INC.
HIGHLAND, N. Y.
225 FOURTH AVENUE, NEW YORK

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The Publisher's News Letter

It has been gratifying to receive the many expressions of approval concerning the account of the races at St. Louis that appeared in AVIATION. With almost the same pressure of time that newspapers are put together, the details of each race were written and with the usual exception which proves the rule the speeds were accurately printed.

AVIATION is always glad to receive cheerful praise. It also accepts criticism in the same appreciative spirit.

* * * *

The St. Louis races have made one fact clear to the aeronautical publications. Our readers probably sensed the fact when they read the issues containing accounts of the races. Compare the aeronautical papers with any other trade paper which appears after an event of great importance. Such issues are filled with advertising of companies who have participated in the affair and capitalize the success of their products. Not so in the aviation field. The ease with which free publicity has been secured for so long has made possible advertisers feel that as they only have to sell to the government there is no advantage in using the trade press. This fallacy is easy to demonstrate but without the facts being made clear it may persist.

* * * *

Our readers include the entire influential group in aviation. When they are told the story of a product in the news columns it is like an introduction to a new friend. It is a courtesy that gives every one pleasure. But when companies that should appropriate a portion of their selling expense for advertising their products simply rely on the free publicity they can secure, the only trade paper rightly feels that its news columns are being used exclusively for publicity purposes.

* * * *

Take the situation confronting the aeronautical publishers. They have seen such strong companies as the Standard, Sturtevant, Hall-Scott, Gallaudet and Dayton-Wright division of the General Motors retire from the aeronautical field for various reasons. The Packard Company that had heavy orders during the war and has done much development work since, having recently completed the engines for the ZR1, is doing nothing to seek good will through the trade press, although its advertising of motor cars has continually utilized the fact that it is in the aeronautical field. The Aeromarine Company stopped all advertising last fall, but it is hoped that after its reorganization is completed it will be represented as it always was in the past. The L.W.F. Company, although having secured large orders from the government, claims as a reason for not seeking publicity that its receivership will not permit it. And so it goes with many others. Our readers can tell the companies that are doing everything possible to make the aeronautical industry a business rather than a subsidized government institution. If it were not for the broad-gaged spirit of a few of the aeronautical companies, there would be no aeronautical papers and no Aeronautical Chamber of Commerce. AVIATION has determined to place the subject of free publicity in its true light before its readers and seek for the forward looking manufacturer the good will to which he is entitled.

* * * *

Our readers may ask what is the use of advertising when the government is practically the only large customer. The answer is clear. A manufacturer of any commodity does not feel that he has completed his sale when he has unloaded his output on the wholesaler or jobber. He tells the user of his product about its advantages through advertising and seeks to secure his approval and create a demand which will bring reorders. It is the same with government purchases. An air mail pilot or a flying officer can do more to create a favorable or unfavorable impression of an aeronautical product than any other person. And yet some aeronautical manufacturers are content to convince the purchasing department and leave the good will to chance. It is the only business in which this is done generally and the state of the industry is a reflection of this policy. From time to time we intend to bring these publication details to the attention of our readers who have so loyally stood by us.

OCTOBER 29, 1923

AVIATION

VOL. XV. NO. 18

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MARTIN BOMBER WINS MERCHANTS EXCHANGE TROPHY AT ST. LOUIS

Lieut. H. L. George, Army Air Service, piloting one of the two Martin-built planes entered in the St. Louis events, was the winner of the Merchants Exchange race; Lieut W. S. Halleberg of the Navy flying the other Martin-built entry, finished third in a field of eight starters.

The significant fact in connection with the winner of this race is that it was accomplished by a plane *five years* old in design -- remarkable testimony to the efficiency in engineering and construction.

At St. Louis, as at Detroit a year ago when the four Martin-built Bombers entered took the first four places in the large capacity class, these planes demonstrated the wisdom of painstaking care and foresight which is given to all Martin products. It is another proof that quality counts.

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AVIATION

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Vol. XV — OCTOBER 29, 1923 — No. 18

Needed — An Air Defense Commission

THE following letter has been sent to President Coolidge by AVIATION:

"The defenseless condition of the United States from air attack has resulted mainly from three causes. 1. Lack of a civilian exponent of our aerial needs in your advisory circle. 2. Lack of any continuing national aircraft policy. 3. The wasteful duplication of agencies of the Government charged with the development of aircraft.

"Increased appropriations, while of great urgency, are not the only factor needed to remedy our present deplorable state of aerial impotency.

"After many years of careful study of our aeronautical progress, the following suggestions are respectfully submitted, in the hope that after the hearings on congressional appropriations are held our air services will not lapse into a state of silent discontent owing to a lack of any continuing policy.

"The first and most urgent need of the country is to have some civilian official among the President's advisors who will consider the aerial arm of the country not primarily from the military or naval viewpoints but as the first line of defense of the country. This obviously cannot be done by the Secretaries of War or the Navy, for they have to rely for advice on officers with specialized training in the older forms of warfare. These officers necessarily have so little knowledge of the possibilities of aircraft that their suggestions are naturally circumscribed by departmental conservatism. In 1921, Secretary Daniels was advised by naval officers that there was nothing to fear from aerial bombs and he publicly offered to board the Ostfriesland and let airplanes attack. In the War Department for the last few months the Air Service has been silenced to a degree unworthy of a country of free opinions and open discussion.

"As this dangerous situation cannot wait for a reorganization of departments, you could, Mr. President, immediately learn the needs of the country from an aerial standpoint by appointing an Air Defense Commission composed of three or four public-spirited men who would make an investigation of the present deplorable condition and recommend directly to you what measures should be taken to make the United States safe from air attack. The proper spending of large aircraft appropriations is as important as securing them from the Congress.

"This Commission could recommend methods for preventing wasteful expenditure of the air appropriations by Government departments, the unnecessary duplication of aircraft development work now going on in the services; it could learn what departmental competition and rivalry in design and procurement of aircraft is costing; it could ascertain why the aircraft industry is in a condition of financial helplessness, owing to the hand-to-mouth policy now prevailing; and what is even more important, it could be empowered to secure from flying officers frank expressions of opinion as to the uses of aircraft in war and the danger from attack of foreign air forces acting independently of military and naval control.

"There is no time to be lost, for it takes several years to carry out plans for aerial preparation. A continuing program spread over a period of years prepared by unprejudiced and broad-minded men in whom the country has confidence is the most essential need of our national defense today. So that our country may have the best available advice of the Commander-in-Chief of our armed forces, it is hoped that you will give this suggestion favorable consideration and give Congress when it convenes the benefit of such an independent Commission's recommendations for our future aircraft development."

The purpose of this letter was to suggest to the President a means of learning from an unprejudiced source the real needs of the country for aeronautical defense, instead of merely the needs of the Army, Navy and Post Office Departments.

At St. Louis, Asst. Secretary of War Davis stated that the Army in 1924 would have a shortage of 1468 airplanes at the present rate of expenditures and "what we are doing is literally starving to death the most vital branch of our national defense. If Congress does not make adequate appropriations in the near future, our air service will be rendered absolutely impotent. Our commercial aviation industry is also being starved to death."

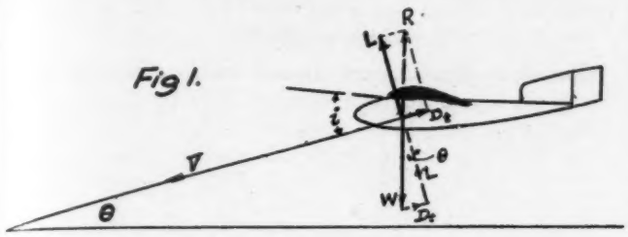
General Patrick said "two and a half years from now, with the money I have in sight, I will have less than three hundred serviceable planes, just one-fifth of what I need for the small force we are allowed to maintain. A single nation (of which we know) in forty hours, can put on our shores three and a half times as many planes as we have in the entire Army."

Admiral Moffett followed with the remark that the naval air force was just twice as badly off as the Army.

With such strong words from those responsible for the air defense of the country, immediate action is required of the President if the United States is to have its place in the air. An independent civilian commission is suggested because the heads of Army and Naval aviation are limited in their requests to the many congressional committees by the budget makers of the Army and Navy. Aviation with them is largely a matter of how much they are permitted to ask for. A civilian commission would consider aviation from the standpoint of the country's needs and not as a part of the Army, Navy and Post Office appropriations. President Coolidge needs advice from outside his official family on this all important national problem and the only way he will get it is from some such advisors.

The National Aeronautic Association, representing as it does every interest in American aeronautics, could render a great service to the country by submitting to the President or to a Commission appointed by him a continuing program for the aeronautical development of not only the Army and Navy but the Post Office Department, civilian aviation, air routes, terminal landing fields, and perhaps the most important subject of all, some form of a national law for aeronautics such as the Winslow Bill.

Here is a real opportunity for the National Aeronautic Association to render a national service.



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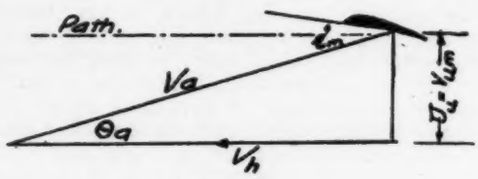

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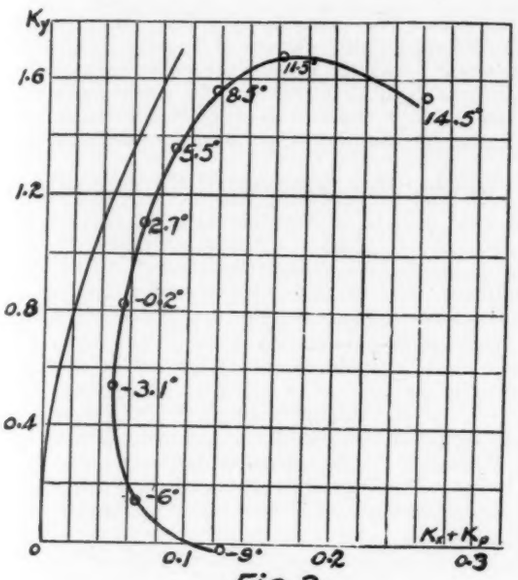

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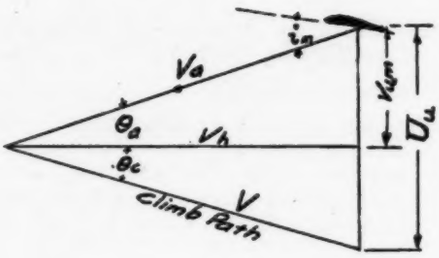

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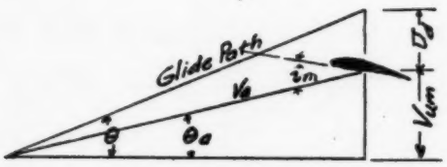

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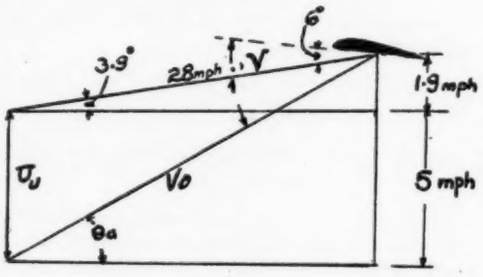

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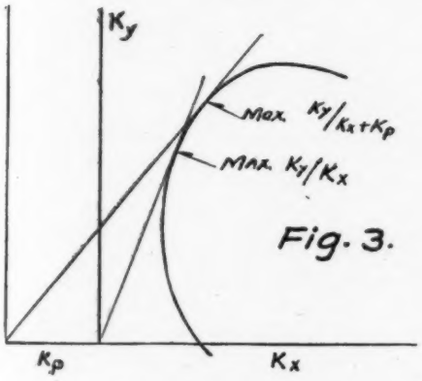

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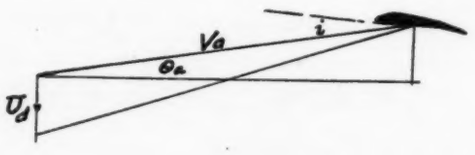

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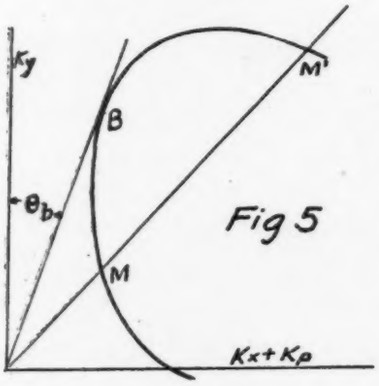

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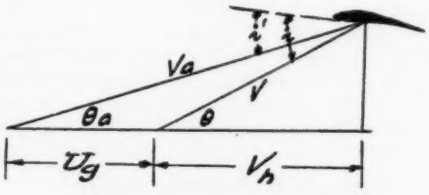

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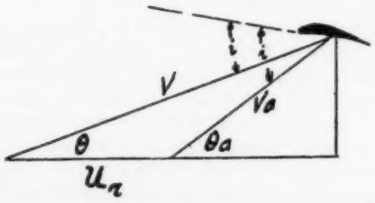


Fig. 12.

Gliding Theory and the Operation of Gliders

By ALEXANDER KLEMIN

Lecturer in Aeronautics, New York University

The best glider pilots maneuver their craft by instinct. Yet a statement of some of the underlying aerodynamic principles may be of interest to such pilots.

PART 1. GLIDING IN STILL AIR

Best Angle of Glide

In Fig 1 is represented a glider, gliding on a path inclined to the horizon, in still air.

Resolving forces perpendicular to the path and along the path, the equations of equilibrium are

$$L = K_y A V^2 = W \cos \theta \quad (1)$$

$$D_t = (k_x + k_p) A V^2 = W \sin \theta \quad (2)$$

where V = velocity on the glide path in mi./hr, W = weight of glider in lb., L = lift in lb., D_t = total drag or resistance in lb., i = angle of incidence of the wing chord to the glide path and in still air to the relative wind, k_y = lift coefficient of the wing in lb. per sq. ft. per mi./hr. at this angle of incidence, k_x = drag coefficient of the wing in lb. per sq. ft. per mi./hr. at same angle of incidence, and k_p = structural resistance or parasite resistance coefficient of the rest of the glider referred to the wing area and also expressed in lb. per sq. ft. per mi./hr. The parasite resistance coefficient may be taken as constant for all angles of incidence.

It follows from the above equations that

$$\tan \theta = \frac{D_t}{L} = \frac{k_x + k_p}{k_y} \quad (3)$$

When the glider is gliding at the angle of incidence i_b which corresponds to the maximum Lift/Drag ratio, θ has a minimum value θ_b which is termed the best gliding angle. A pilot who is at a given altitude and wishes to cover the greatest possible horizontal distance while coming down must determine values of θ_b and i_b for best glide by instinct, experiment or computation.

For the Hannover glider described in AVIATION for Aug. 7, 1922, the aerodynamic characteristics are shown in Fig. 2, where k_y is plotted against $(k_x + k_p)$ in German absolute units, as determined in the wind-tunnel. The best value of L/D_t for the Hannover glider is extremely high, namely 16 to 1, and occurs at an angle of incidence of 2 deg. As a rule, airplanes fall far below this value of 16 to 1, and few gliders attain it. Also, the best value of L/D is generally found at a higher angle of incidence. The best L/D for a wing alone occurs at about 4 deg., and the effect of adding the constant parasite resistance coefficient k_p is to increase the incidence for best L/D_t some two degrees or so. This is illustrated diagramatically in Fig. 3. A glider pilot may reasonably expect a 6 deg. incidence to the glide path to give him the best results, as far as gliding to cover the maximum horizontal distance is concerned. And a glide path of 1 in 10 or 12 is not an unreasonable value to ask of the glider designer or builder. It is suggested that some simple form of inclinometer might be highly useful to a pilot when first experimenting with his machine.

From the above equations it follows that the angle of glide is independent of the loading per square foot. In other words a fast, high load airplane, having a maximum L/D_t of 16 and a wing loading of 10 lb./sq. ft., will glide on the same inclination of path as the Hannover glider of 2.75 lb./sq. ft. loading. But in either airplane or glider design, it will be easier to obtain a large value of L/D_t where the loading is light and the wing area correspondingly large, since the parasite resistance is almost independent of the wing area, and k_p will become small with large wing area.

Minimum Loss of Altitude in Still Air

It is sometimes stated that aerodynamically all that a glider requires is a small best gliding angle. This is true when it is sought to cover the greatest horizontal distance with a given loss of altitude. It is also true when the glider is to be launched on a very gentle slope. But the pilot may have another object in view, namely to lose altitude as slowly as possible in still air with no very definite point to reach, but just the desire to stay up as long as possible in the expectation of a rising current of air. For this purpose light loading is most important. The vertical component of velocity on the glide V_u is $V \sin \theta$. Since $V = \sqrt{\frac{W}{A}\frac{\cos\theta}{k_y}}$, $V \sin \theta = \sqrt{\frac{W}{A}\frac{\cos\theta}{k_y}} \sin\theta$, and $\tan \theta = \frac{k_x + k_p}{k_y}$, it can readily be shown that

$$V \sin \theta = \sqrt{\frac{W}{A} \sin^3 \theta / (k_x + k_p)} \quad (4)$$

In order that altitude may be lost as slowly as possible, W/A should be as low as possible and also $\frac{\sin^3\theta}{k_x + k_p}$ should be as small as possible. This expression can be reduced to a simpler approximate form. Sin θ is nearly equal to tan θ and $\tan \theta = \frac{k_x + k_p}{k_y}$, $\frac{\sin^3\theta}{k_x + k_p} = \frac{(k_x + k_p)^3}{k_y^3}$

Therefore

$$V_u = \sqrt{\frac{W}{A} \cdot \frac{(k_x + k_p)^3}{k_y^3}} \text{ or } V_u = \sqrt{\frac{W}{A} \cdot \frac{1}{(L/D_t)^3 k_y}} \quad (5)$$

It follows from this that not only high L/D_t and low W/A are desirable, but the highest possible value of the product $(L/D_t)^3 k_y$. The glider designer selecting a suitable wing section may find it useful to assume values of k_p and A, and plot the expression $(L/D_t)^3 k_y$ against angle of incidence for a number of different wings.

It can by no means be assumed that maximum L/D_t and maximum $(L/D_t)^3 k_y$ occur at the same angle of incidence, and the pilot may be interested to know at what value of the angle of incidence i to the glide path and at what corresponding glide path he will lose altitude most slowly. This can be studied in a general way from the curves of k_y against $k_x + k_p$ of Fig. 5. If the glide is made at an angle other than θ_b, the best gliding angle, there are two possible conditions of glide, at points M and M^1. From these two points the flight path inclination will be the same, but at M^1 the speed will be less since k_y is greater there. Hence the loss of altitude at M^1 will be less. Airplane pilots, if not gliding down at point B are more likely to glide at some lower angle of incidence to avoid the danger of stalling. For a glider pilot wishing to have the minimum loss of altitude, gliding must be maintained not at B but at some point above B in the direction of M^1 on the curve—at the point where $(L/D_t)^3 k_y$ is a maximum. It can be readily shown that the incidence at which minimum power is expended in horizontal flight, is also the incidence at which minimum altitude is lost. Horsepower in horizontal flight $= \frac{TV}{375}$ (where T = thrust in lb. and V = horizontal speed in mi./hr.) $\frac{1}{375}\frac{W}{L/D_t}\sqrt{\frac{W}{Ak_y}} = \frac{W}{375}\sqrt{\frac{W}{A(L/D_t)^3 k_y}}$ and the same expression $(L/D_t)^3 k_y$ must be a maximum in both cases. It is known that incidence for minimum power is somewhat greater than incidence for best glide, because the L/D_t drops off fairly slowly above the incidence i, while the k_y increases on a straight line.

To confirm these considerations, computations were made for the Hannover glider. The results of these computations

PART 3. GLIDING WITH STEADY HORIZONTAL CURRENTS

Gliding with Rear-on Wind

It is sometimes assumed that since in a steady horizontal wind the glider eventually assumes the velocity of the surrounding air, the best angle of glide will be the same as in still air. This is not true. If in Fig. 12 (subsequently used to illustrate another problem) U_r is the rear-on wind, then the velocity V relative to the earth is greater than the velocity V_a relative to the air, and the glide angle θ relative to the earth is smaller than the glide angle relative to the air θ_a. The criterion of best glide is that θ be as small as possible or $\cot \theta$ be as large as possible. Now

$$\cot \theta = \frac{U + V \cos \theta_a}{V \sin \theta_a} = \frac{V \cos \theta_a}{V \sin \theta_a} + \frac{U}{V \sin \theta_a}$$

$$= L/D_t + \frac{U}{\sqrt{\frac{W}{A}\,\frac{1}{(L/D_t)^2 k_y}}} \quad \text{approximately} \qquad (7)$$

If U_r is small then evidently the best angle of glide will occur at the incidence corresponding to best L/D_t. But if U_r is large then the second term becomes important, and $(L/D_t)^2 k_y$ must be as large as possible. This has a maximum value at angle i_m of least loss of altitude in still air. It is evident therefore that with a rear-on wind the path relative to the air should be somewhat steeper than for best glide in still air, and at an angle of incidence somewhat greater relative to the air—somewhere between the attitude of best glide and the attitude of minimum loss of altitude.

Gliding with Head-on Wind

Referring to Fig. 2 (subsequently used to illustrate another problem), if U_g is the head-on wind, then the velocity V relative to the earth is less than the velocity V_a relative to the air, and the glide angle relative to the earth θ is greater than the glide angle relative to the air θ_a. The criterion of best glide is again that $\cot \theta$ be as large as possible Now $\cot \theta = \frac{V \cos \theta_a - U_g}{V \sin \theta_a} = L/D_t - U\sqrt{\frac{A}{W}} \cdot \sqrt{(L/D_t)^2 k_y}$ (8)

If U_g is small then evidently the best angle of glide will occur at the incidence corresponding to best L/D_t. But if U_g is large, then the expression $(L/D_t)^2 k_y$ must be as small as possible. In other words, k_y should be small, and hence with a large head-on wind the pilot should nose his machine down relative to the horizontal a little more steeply than on path of best glide in still air, and also glide at a smaller angle of incidence relative to the air.

Minimum Loss of Altitude in Horizontal Currents

Here on the other hand, the attitude of the glider is independent of the horizontal currents, and least loss of altitude in a given time will occur at the same attitude as for gliding in still air.

PART 4. ENCOUNTERING GUSTS

Encountering an Up-Gust or Current

In considering the effects of gusts, the problem is much more difficult than for steady currents. Since acceleration is introduced the solution of the equation of motion becomes extremely difficult, if not impossible. As all the coefficients vary with the incidence step by step integration is almost the only practical method of solution. And since the pilot can maneuver his machine in a number of ways, the work of calculation to find the optimum operation would be absolutely prohibitive. It is however possible to state with fair accuracy what the pilot should do initially and this should be sufficient guidance to an experienced and observant man.

In Fig. 9 let us assume that the machine is gliding in still air at the attitude of minimum loss of altitude, and a sudden upward current U_u is encountered. Owing to the momentum of the machine it may be assumed that the velocity of the glider relative to the earth remains momentarily unchanged. But as seen from this diagram, the relative air velocity V_a is slightly larger than the original V and the angle of incidence is increased to the large value i'. The equations of motion become:—

$$(k_{y1}' A V_a^2) \sin \theta_a - (k_p + k_{y1}')\, A V_a^2 \cos \theta_a = \frac{W}{g}\,\frac{dV_h}{dt} \qquad (9)$$

$$(k_1' A V_a^2) \cos \theta_a + (k_p + k_{x1}')\, A V_a^2 \sin \theta_a = W + \frac{W dV_u}{g dt} \qquad (10)$$

Two effects are produced, an acceleration in the upward direction given by the value of $\frac{dV_u}{dt}$ and an acceleration in the horizontal direction $\frac{dV_h}{dt}$ owing to the forward inclination of the lift force L.

When a steady upward current is encountered, the problem of the pilot is to take up the upward velocity as quickly as possible. In the case of a sudden up-gust which dies down subsequently, the problem is to gain as much altitude as possible. The increase in forward or horizontal velocity is only indirectly beneficial, since such increase will have to be transformed into upward energy to be of any benefit. It is fairly correct to say that in both cases the ratio of $\frac{dV_u/dt}{DV_h/dt}$ should be as great as possible, and that the pilot should maneuver his machine in the same manner initially. He cannot vary the initial values of V_a or θ_a, but he can vary the angle of incidence to the line of relative air velocity and give it any value i'. We shall take some concrete cases to illustrate the maneuvers.

The most convenient form in which to write the ratio $\frac{dV_u/dt}{DV_h/dt}$ is

$$\frac{dV_u}{dt} \Big/ \frac{dV_h}{dt} = \frac{k_{y1}' \cos \theta_a + (k_p + k_{y1}') \sin \theta_a - \frac{W}{AV_a^2}}{k_{y1}' \sin \theta_a - (k_p + k_{x1}') \cos \theta_a} \qquad (11)$$

And in calculation it is possible to neglect the expression $(k_p + k_{x1}')\ sin\ \theta_a$ and to make $cos\ \theta_a$ equal to unit.

Taking the case of a 5 mi./hr. upward current, we find $\theta_a = 13.2$ deg. and the above expression has a maximum value when $i' = 14$ deg. The angle of wing chord to horizontal becomes 14 deg. — 13.2 deg. = 0.8 deg. so that in meeting this upward current the machine is nosed down slightly to the horizontal.

Taking the case of a smaller upward current of 1.9 mi./hr., we find $\theta_a = 7.6$ deg. and maximum value of the above ratio when $i' = 12$ deg. The angle to the horizontal is then 12 deg. — 7.6 deg. = 4.4 deg., so that while the angle of incidence relative to the air should still be large, the machine does not need to be nosed down from its original flight attitude of 2.1 deg. to the horizontal. In fact it should be nosed up slightly. But the rule is to make the angle of incidence with the resultant air velocity approach the incidence of k_y maximum.

Eventually, when the steady upward velocity has been obtained, the glider should take up the normal attitude for maximum climb, or if the gust dies down the normal attitude for minimum loss of altitude.

Encountering a Down-Gust

The equations of motion are the same as in the case of the up-gust. Assuming again that the glider retains momentarily its original velocity relative to the earth owing to its momentum, the initial condition is illustrated in Fig. 10. The relative air velocity is decreased slightly and the angle of incidence is decreased considerably. There arise both downward acceleration and horizontal deceleration. The pilot's problem is to keep both downward acceleration and horizontal deceleration at a minimum value.

In the case of a downward gust of 5 mi./hr., when the glider is gliding at the normal attitude of minimum loss of altitude, θ_a actually assumes a negative value of 6.3 deg. and

with a wing loading of 2.75 lb./sq. ft. are shown in the curves of Fig. 4 where k_y and k_x are in British Absolute units. The angle of best glide θ_b is 3.6 deg. at $i = 2$ deg. incidence. At this attitude the downward vertical velocity is less than 1.9 mi./hr.. At 0 deg. incidence the downward vertical velocity is 2.45 mi./hr., quite appreciably more. It therefore seems advisable for the glider pilot seeking minimum loss of altitude to fly decidedly above incidence of best glide rather than below it. It should be noted again that the Hannover glider has a very low incidence for best gliding angle, and on the average airplane with best L/D_t at round 6 deg., the incidence i for least loss of altitude might therefore be as high as 10 deg. Computation or experiment must be used to determine this for each particular type of glider.

Maximum and Minimum Horizontal Velocity on a Glide in Still Air

The horizontal velocity on the glide

$$V \cos\theta = \sqrt{\frac{W \cos\theta}{k_y A}} \cdot \cos\theta = \sqrt{\frac{W \cos^3\theta}{k_y A}} \qquad (6)$$

It might on rare occasions be of interest to obtain the greatest horizontal velocity irrespective of the loss of altitude, though this is more likely to be of interest to an airplane pilot landing in a great hurry than to a glider pilot. Calculating $\sqrt{\frac{W \cos^3\theta}{A\, k_y}}$ for small values of i for the Hannover glider, we find that for maximum horizontal velocity, the glide becomes more of a dive. The maximum horizontal velocity is approximately 70 mi./hr. on a glide path of 45 deg. so that loss of altitude would likewise be at the rate of 70 mi./hr.

The horizontal velocity within normal range of gliding angles is practically the same as the total gliding speed and is therefore a minimum at the slowest gliding speed or at the angle of incidence of maximum k_y.

PART 2. GLIDING WITH STEADY VERTICAL CURRENTS

Horizontal Glide with Minimum Steady Rising Current

If in Fig. 6 we denote by V_h the horizontal velocity of the glider and by U_u the velocity of a rising current of air, the glider while maintaining a horizontal motion relative to earth, travels with velocity V_a on a fictitious downward gliding path relative to the air of inclination θ_a. Just as in a real glide $V_u = V \sin\theta_a =$

$\sqrt{\frac{W}{A} \cdot \frac{\sin^3\theta_a}{k_x + k_p}}$, ($V_{um}$ denoting minimum vertical velocity of the glider)

which is identical with the expression of equation (4) for the velocity of vertical descent.

Therefore the minimum rising current $U_u = V_{um}$ to sustain horizontal flight in the case of the Hannover glider will be 1.9 mi./hr. and the correct flight attitude will be 6 deg. incidence to a fictitious glide path of 3.9 deg. The angle between the chord of the wing and the horizontal will be 6 deg — 3.9 deg. = 2.1 deg. With this minimum rising current of air, therefore, the pilot should raise the leading edge of his wing to make a small angle with the horizontal for this particular glider.

Best Climb on a Rising Current

When the upward current of air surpasses in velocity the minimum required for horizontal flight, a "climbing glide" may result. It can be seen from Fig. 7 that the rate of climb $= U_u - V_a \sin\theta_a = U_u - V_u$ and best climb will follow when V_u has its minimum value V_{um}. It follows that the correct attitude relative to the horizontal will be exactly the same as in the previous case for steady horizontal flight with minimum rising current, namely 2.1 deg. between the wing chord and the horizontal. The attitude to the horizontal should therefore always be the same, however powerful the rising current may be, although the climb will increase with the power of the rising current. This fact may be of considerable interest to glider pilots, who might quite naturally suppose that they should nose a machine up for best climb as in the case of climbing a powered airplane.

Greatest Horizontal Speed with a Rising Current

If the rising current is greater than the minimum required for the maintenance of horizontal flight, the pilot may prefer not to climb, but to secure the greatest horizontal velocity, without losing altitude. The equilibrium condition will again be illustrated by Fig. 6, except that V_u will not be restricted to its minimum value V_{um}. For any rising current U_u we shall have $V_u = U_u$, and from the curve of vertical speeds of Fig. 4 we can obtain the angle θ_a of the fictitious glide path, the corresponding angle of incidence, and the gliding speed V_a, which for small angles of θ may be taken as approximately equal to V_h.

It can be seen from the curves of Fig. 4 that the greater the vertical speed or rising current the greater the possible horizontal speed. And the greater the rising current the steeper the fictitious flight path will be. In other words, if a pilot does not wish to climb with a powerful rising current he should nose his machine down with proportionate sharpness.

Gliding in a Downward Current of Air

The pilot may be so unfortunate as to encounter a downward current of air U_d, as illustrated in Fig. 8. Here the actual angle of glide to the horizontal θ is greater than θ_a, the fictitious angle of glide or angle of glide relative to the air. The total downward velocity is $U_d + V_u$ and V_u must have its minimum velocity V_{um}.

The correct attitude of the glider to the horizontal will therefore be the same as in still air with minimum loss of altitude. θ_a for the Hannover glider will therefore be 3.9 deg. and the incidence i will be 6 deg., so that the wing chord will again make with the horizontal an angle of 6 deg. — 3.9 deg. = 2.1 deg. This correct attitude will be independent of the intensity of the downward gust—a very important point for glider pilots.

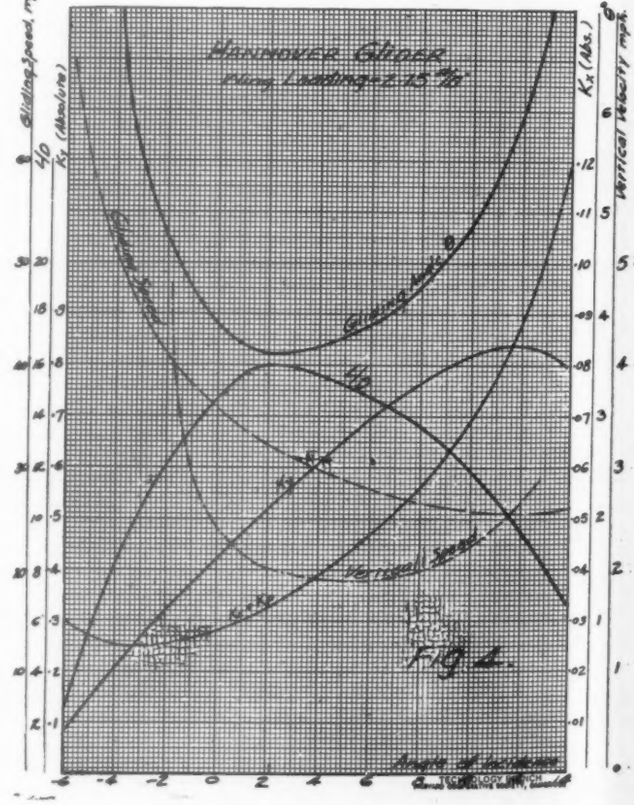


Fig. 4. Aerodynamic characteristics of the Hannover glider "Vampire"

the relative air velocity is at a negative angle of 4.1 deg. to the wing chord. This should evidently produce a great downward acceleration and a large horizontal deceleration. There is no doubt that the proper thing for the pilot to do is to nose his machine up in proportion to the sharpness of the downward current, and detailed calculations are not required to demonstrate this.

Meeting a Head-on Gust

If the glider is flying in the normal attitude of minimum loss of altitude and meets a head-on gust, then if velocity relative to the earth is momentarily unchanged, it can be seen from Fig. 11 that the relative air velocity will be increased and the angle of incidence diminished. The equations of motion will be the same as in equations (9) and (10).

Two effects will be produced, first, a deceleration in the horizontal direction, and second, an acceleration in the vertical direction. The problem of the pilot in taking advantage of this head-on wind is to gain as much altitude as possible while the glider is assuming the velocity of the head-on wind.

The two equations of motion may be simplified as before by putting $\cos \theta_a = 1$ and neglecting the term $(k_p + k_{y1})$ $\sin \theta_a$ which is the product of relatively small numbers. The equations then become

$$(k_{y1}' A V_a^2) \sin \theta_a - (k_p + k_{x1}') A V_a^2 = \frac{W}{g} \frac{dV_h}{dt} \qquad (12)$$

$$k_{y1} A V_a^2 = W + \frac{W dV_u}{g dt} \qquad (13)$$

To utilize a head-on gust it is not correct to say that maximum acceleration is required, or even that maximum ratio of $\frac{DV_u}{dt} / \frac{DV_h}{dt}$ should be obtained. We can analyze the problem as follows:—

Let Δt be a short interval of time for which V_a and θ_a remain substantially constant, and let the horizontal velocity be diminished during this interval of time by an amount $\left(\frac{V_h}{k}\right)$ where k is a large constant.

Then the gain in altitude during this interval of time is $\left(\frac{dV_u}{dt}\right) \frac{\Delta t^2}{2}$ and since $\frac{V_h}{k} = \left(\frac{DV_h}{dt}\right) \Delta t$, we have

$$\Delta t = \frac{V_h}{k \left(\frac{DV_h}{dt}\right)}$$

The altitude gained will therefore be greatest when $\frac{dV_u}{dt} \left(\frac{V_h}{k}\right)^2 \frac{1}{\left(\frac{DV_h}{dt}\right)^2}$ is a maximum, that is when $\frac{dV_u}{dt} \cdot \frac{1}{\left(\frac{dV_h}{dt}\right)^3}$ is a maximum. In other words, when the ratio of upward acceleration to the inverse of the horizontal deceleration squared is as great as is possible. And $\frac{dV_u}{dt} \frac{1}{\left(\frac{dV_h}{dt}\right)^2}$ will evidently be a maximum when $\frac{k_{y1}' - \frac{W}{A V_a^2}}{[k_{y1} \sin \theta_a - (k_p + k_{x1}')]^2}$ is a maximum.

There is apparently no general rule to obtain a maximum value for this expression, but we can take a concrete case with the Hannover glider in its normal attitude of minimum loss of altitude, with $\theta = 3.9$ deg., $i = 6$ deg. and angle of wing to horizontal 2.1 deg., while V is 28 mi./hr. Suppose the glider suddenly meets a horizontal wind of 10 mi./hr. Substituting different values of i' in the above ratio, we find a maximum value for $i' = 4$ deg. approximately, and since θ_a becomes 2.9 deg. when the 10 mi./hr. gust is encountered, the angle between wing chord and horizontal is 4 deg. — 2.9 deg. = 1.1 deg. If the velocity of the steady horizontal wind is assumed to be 20 mi./hr., θ_a becomes 2.3 deg. and the maximum value of the above ratio occurs when $i' = 2$ deg. approximately, and angle of wing chord to the horizontal is 2 deg. — 2.3 deg. = —0.3 deg.

That is to say, when suddenly meeting a head-on wind, the pilot should nose his machine down slightly to the horizontal a little more when the head-on wind is large. As the machine gradually decelerates relative to the earth and its velocity relative to the air diminishes, the pilot should nose the glider up to its original normal attitude.

If the head-on wind strikes the machine gradually, even if it ultimately grows to a large value, the relative air velocity V_a will always be only slightly greater than the original velocity V and only a slight nosing down of the glider will be necessary, for while the horizontal head-on wind is growing, the glider is simultaneously decelerating relative to the earth.

Meeting a Rear-on Gust

A rear-on gust, as can be seen from Fig. 12, increases the angle of incidence, but reduces the velocity of the air relative to the glider, and also makes the path relative to the air very steep. The equations of motion are as before (9) and (10). But since θ_a is much larger we cannot always put $\cos \theta_a$ equal to unity or neglect the expression $(k_p + k_x) \sin \theta_a$. But there is in this case a forward acceleration and a downward acceleration. The problem in this case is to have $\frac{dV_u}{dt} \cdot \frac{1}{\left(\frac{dV_h}{dt}\right)^2}$ a minimum or

$$\frac{k_{y1}' \cos \theta_a + (k_p + k_{x1}') \sin \theta_a - \frac{W}{A V_a^2}}{[k_{y1} \sin \theta_a - (k_p + k_{x1}') \cos \theta_a]^2}$$

a minimum.

Since no general rule is available to give this expression a minimum value, concrete cases must again be taken. If the rear-on wind is 10 mi./hr., θ_a becomes 6 deg. The above expression is a minimum when $i' = 8$ deg. and the angle with the horizontal is 2 deg. The glider's attitude to the horizontal can therefore remain unchanged.

If the rear-on wind is 20 mi./hr. making $\theta_a = 13.4$ deg., the expression is a minimum when i' is approximately 8 deg. and the angle with the horizontal is 8 deg. — 13.4 deg. = —5.4 deg. In this case the glider should be nosed down quite considerably from its original attitude.

Summary

Following is a summary of the gliding theory developed above.

Gliding in Still Air—(a) To cover the greatest horizontal distance, for a given loss of altitude, glide at best angle of glide, at the incidence for which L/D_t is maximum.

(b) To secure minimum loss of altitude, glide on such a path that for the corresponding angle of incidence $(L/D_t)^3 K_y$ is a maximum. The glide will be steeper and the angle of incidence greater than for best glide.

(c) To secure minimum horizontal speed, glide at angles of incidence approaching stalling. To secure maximum horizontal speed, glide at an angle of 45 deg. to the horizontal.

Gliding with Steady Vertical Currents—(a) To glide with minimum rising current, altitude of wing chord to horizontal should be the same as on the glide in still air with minimum loss of altitude.

(b) For best climb on a rising current, altitude of wing chord to horizontal should be the same as on the glide in still air with minimum loss of altitude.

(c) In gliding in a downward current of air, altitude of

wing chord to horizontal should be the same as on the glide in still air with minimum loss of altitude.

Gliding with Steady Horizontal Currents—(a) With a rear-on wind, best glide will be on a steeper path to the horizontal and with a larger angle of incidence to the relative air velocity than for best glide in still air.

(b) With a head-on wind, best glide will be on a steeper path to the horizontal but with a smaller angle of incidence to the relative air velocity than for best glide in still air.

(c) Minimum loss of altitude will be independent of steady horizontal currents and correct altitude will be the same as in still air.

Encountering Gusts—(a) When encountering an up-gust, angle of incidence with the relative air velocity should approach stalling angle. If the up-gust is slight, altitude to horizontal may be unchanged, or machine nosed up slightly. If meeting a violent up-gust, machine should be nosed down.

(b) When meeting a down-gust, nose the machine down in proportion to the sharpness of the down-gust.

(c) When meeting a head-on gust, nose down slightly.

(d) When meeting a rear-on gust, nose down considerable.

These rules are tentative, and the whole article is only an introduction to the study of the subject. Also the technique of wind perception is not yet fully developed. But the article may set pilots and designers thinking.

New Arctic Flying Expedition

Haakon J. Hammer of Seattle, the leader of the Hammer-Junkers expedition which last summer flew from Spitzbergen to within 600 miles of the North Pole, recently arrived in New York. He stated that he had worked out a plan with the Junkers Airplane Co. of Germany with a view to fly next summer across and around the North Pole with three planes.

The Hammer-Junkers expedition went to Spitzbergen last June for the purpose of rescuing Roald Amundsen if he should fail to arrive on schedule time at Spitzbergen after his take-off from Wainwright, Alaska. The expedition consisted in addition to Mr. Hammer, of Arthur Neumann, pilot of the Junkers float plane which carried the party to Spitzbergen from Norway, and of Mr. Loewe, technical adviser.

As there is no telegraph at Wainwright, Amundsen planned to have news of his flight relayed by bonfires a few miles apart which Eskimos were to light one after another after the original signal fire began to blaze at Wainwright. The train of bonfires would have carried the news to the nearest radio station where it would have been repeated all over the world and eventually received at Spitzbergen. But this elaborate plan went to nothing because the discoverer of the South Pole found that his fuel supply was insufficient to carry him across the North Pole and he therefore abandoned the project.

In the meantime, however, Mr. Hammer did much flying around Spitzbergen where he made interesting discoveries and took unique snapshots and motion pictures. No airplane had even been on Spitzbergen before. Very little of the island has been explored, and the pictures give the bird's-eye view of hundreds of square miles which have never been explored.

Spitzbergen is 600 miles from the pole and North Alaska is 1,200 miles from the pole, but Amundsen was eager to hop off from Alaska because between there and the pole lies an unexplored region of 50,000 square miles, where there is believed to be a large expanse of solid land. This is the only big blank on modern maps.

The thorough exploration of this unknown region next year is planned by Mr. Hammer with his fleet of three planes. The start of the next expedition would be north of Spitzbergen.

"We would send a mother ship about 100 miles north of Spitzbergen, or about 500 miles from the pole," Mr. Hammer is quoted by the *New York Herald*. "The ice makes it impossible to send a ship further north. We would take cameras and motion picture outfits on each trip and expect to make a large number of stops in the unexplored area where many explorers think there is a large body of land.

"Mr. Amundsen will lead this expedition, unless his experiences in Alaska have caused him to decide to abandon this sort of an expedition. If he decides not to lead it, I will do so. The Junkers Co. and one other are interested in making planes for the flight. These would carry large supplies of gasoline and not more than three men on each, the pilot, the navigator and the photographer."

These would be flying boats with ski attachments for landing on snow. If the new polar island or continent is found, landings would be made at least every 200 miles, and this would involve eight or ten stops en route from the mother ship to Alaska.

P. & A. Photo

Arthur Neumann, chief pilot of the Hammer-Junkers expedition which flew within 600 miles of the North Pole

Mr. Hammer said his air studies at Spitzbergen had shown that the only safe guide for the air navigator is the sun, which shines twenty-four hours a day. The behavior of the compass was hopelessly bad. The magnetic pole, as is well known, does not correspond with the geographical pole and is at no fixed point, but oscillates over a wide area. There were other conditions which made the magnetic needle erratic. The curvature of the earth changes near its icy crown, causing gravitational disturbances. The speed of the plane, its vibration, the flattened dome of the earth and wild magnetic field together caused the compass needle not only to dance eastward and westward but occasionally to perform complete revolutions.

Goerz, the German lens maker, has produced a motion picture camera, Mr. Hammer said, which would enable the airman who reached the pole to show photographic proof that he has done so. This camera can be used to take in sea or land and the sun at the same time, and from the position of the sun in the series of photographs the geographical position of the plane can be calculated.

Mr. Hammer has visited the Bureau of Aeronautics, Navy Department, and discussed with Admiral Moffett the proposed voyage of the ZR1 to the North Pole.

Final Gordon Bennett Results

The official results of the Gordon Bennett balloon race were announced on Oct. 5 by the Aero Club of Belgium after President Jacobs had expressed condolences to the American, Swiss and Spanish clubs for the casualties sustained during the race.

The list of the standing of the aeronauts in the race was given as follows:

Demuyter, Belgium, 1,155 km.
Veenstra, Belgium, 1,005 km.
Armbruster, Switzerland, 546 km.
Guillen, Spain, 328 km.
Bienaimé, France, 282 km.
Lawrence, United States Navy, 175 km.

President Jacobs, after the reading of the official standings, handed Demuyter the Gordon Bennett Cup and a gold chronometer presented by King Albert of Belgium.

Aeromarine Model AMC Commercial Flying Boat

Features of New Commercial Passenger Carrier Based on Air Line Operation

Although excellent operation was achieved by the Aeromarine Airways with the use of reconstructed war-time craft, it was clear to Aeromarine engineers that better machines would be needed in the near future. It was clearly realized that two or three years would elapse before new machines would be available for commercial operation and that new development must start without delay. It was decided to begin with the construction of a flying boat to replace the six-seater boats now in service. These boats though being of a practical size and type, suffered some drawbacks such as difficulty of take-off with full load, insufficient flying performance, and some structural weakness of the bottom which required frequent repairs. Moreover, satisfactory craft, when first launched, lose their performance after the first month in the water due to water soakage of wooden hull.

The six-seater boats are used for "beach hopping" as well as for communication between distant points, and must possess the qualities required for both occasions. "Beach hopping" requires quick take-off, good climb and very sturdy bottom to withstand as many as twenty or thirty landings a day, while long distance work requires sufficient fuel capacity, good speed and a seaworthy hull.

General Features

In compliance with above requirements the design was laid out for a biplane flying boat with metal hull and tail surfaces, spruce and fabric wings, and one Liberty 12 motor driving pusher propeller. The lower wing was made of smaller chord and span than the upper one in order to improve the aerodynamic efficiency and to avoid damage from high seas. For this reason also the ailerons were fitted only to the upper wings.

The lines of the AMC hull received particular consideration from the viewpoints of passenger accommodation, seaworthiness, ease of take-off and air resistance. The hull can accommodate seven passengers in addition to the crew of two, and is wide enough for four persons to sit abreast. The bottom has "V" shape with included angle of 152 deg. at the step, and a still sharper angle toward the bow. The step is 5 in. deep and the bottom back of it rises at the angle of 8 deg. toward the stern, insuring clean running before take-off.

Wing tip pontoons have been for long time a source of worry to pilots and designers. Their shape was not satisfactory aerodynamically, nor in action on the water. They often leak and not infrequently the high seas would wash them off in case of forced landing. The AMC pontoons have an almost perfect streamline shape in plan and elevation, with square cross sections set on the edge. The pointed stern of small displacement and 90 deg. "V" bottom resulted in the lifting force either due to buoyancy or hydroplaning, being developed gradually without destructive shocks.

The specifications of the AMC flying boat are as follows:

CHARACTERISTICS OF AEROMARINE AMC FLYING BOAT

General

Type	Biplane Flying Boat
Purpose	Commercial Passenger Carrier
Number in Crew	Two
Passenger capacity:	
For flights of 7 hr. duration	5 passengers
For flights of 4 hr. or under	7 passengers

Dimensions

Span, upper wing	65 ft. 0 in.
Span, lower wing	48 ft. 6½ in.
Length, overall	32 ft. 10 in.
Chord, upper wing	7 ft. 0 in.
Chord, lower wing	5 ft. 1 in.
Angle of incidence, both wings	4½ deg.
Dihedral, Lower wing	3 deg.
Dihedral, Upper wing	none
Sweepback	none
Wing curve, upper	Aeromarine No. 2
Wing curve, lower	Aeromarine No. 6

Areas

Upper wing with ailerons	434 sq. ft.
Lower wing	218 sq. ft.
Total wing area	652 sq. ft.
Horizontal stabilizer	53.0 sq. ft.
Elevator	35.5 sq. ft.
Vertical fin	21.5 sq. ft.
Rudder	21.6 sq. ft.

Weights

Weight, fully loaded	6100 lb.
Weight empty, with water	3660 lb.
Disposable load:	
5 passengers	900 lb.
Crew of two	360 lb.
Anchor and rope	60 lb.
Miscellaneous equipment	60 lb.
Fuel and oil	1060 lb.
Total disposable load	2440 lb.
Wing loading	9.35 lb./sq. ft.
Power loading	15.25 lb./hp.

Performance

High speed (1700 r.p.m.)	98 mi./hr.
Cruising speed (1400 r.p.m.)	80 mi./hr.
Min. flying speed (1150 r.p.m.)	60 mi./hr.
Landing speed (estimated)	50 mi./hr.
Climb in 10 min.	3300 ft.
Ceiling, absolute	14,000 ft.

Details of Construction

The wings are constructed of spruce I beams and built up trussed ribs. Upper wing is made in three panels. The center panel of 7 ft. span is rigidly mounted on the motor support and carries two gasoline tanks. The narrow ailerons are fitted to the upper outer wing panels and occupy almost two thirds of the total wing spread. Their narrowness, with the rounded shape of wing tips and small balancing panels mounted on duralumin masts, is responsible for the effective and light lateral control. No non-skid planes are employed as the thick wings and wing gasoline tanks fulfill their function. The aileron control cables run inside of wing panels in aluminum alloy conduits, so as to reduce air resistance, yet be easily removable if required. All controls and control cable pulleys are mounted on ball bearings.

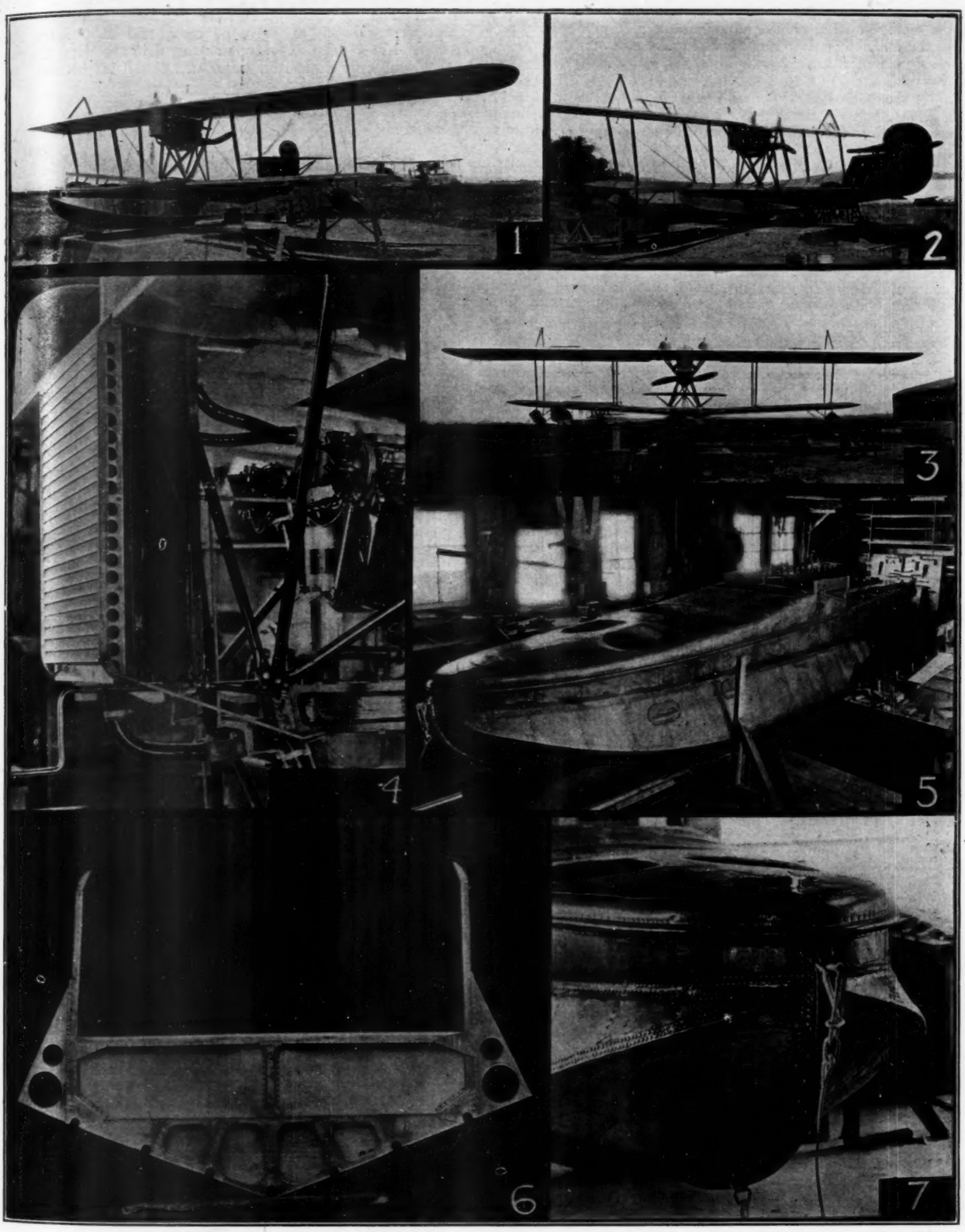
The tail surfaces are constructed entirely of 17S alloy sheets* except for fabric covering. The channel sections of No. 22 B&S gage metal are employed for the ribs and minor braces. Built-up box sections of No. 20 and No. 18 gage are used for the main posts in the fin, while 1/16 in. thick riveted tubes are used for rear beam of the stabilizer and for elevator and rudder. All joints are exclusively made by riveting, which gives insurance of a strong and reliable job. This construction was used up to this time in three different designs, five machines in all, and has given complete satisfaction both from the manufacturing and service points of view. The photograph of uncovered stabilizer and elevator frames appeared in AVIATION of April 16, 1923. The weight of these parts is only 0.53 lb. per square foot of area.

Power Plant Installation

The power plant installation received utmost consideration of the designers as it is here that the cornerstone of reliable commercial operation lies. The width and stiffness of the hull represents an excellent foundation. The motor support is entirely built up of heavy steel tubing, with the exception of the engine bearers which are laminated spruce with ash faces. The truss is so laid out that cable bracing is eliminated and with it is obviated all the tendency to vibrate.

The radiator shown in Fig. 4 is made of 9 in. cartridge tubes and has a frontal area of 620 sq. in. The amount of cooling can be controlled by aluminum alloy shutters which are operated by push and pull rods from the pilot's cockpit. The radiator is suspended from the center panel and is only slightly braced to the motor installation proper. This arrangement was adopted to save the radiator from vibration of the motor so destructive to the core.

*17S. Alloy is the copper-manganese aluminum alloy produced by the Aluminum Co. of America. It is often referred to as "duralumin."



General and detail views of the metal hull Aeromarine model AMC commercial flying boat, powered with a 400 hp. Liberty engine.—Fig. 1. Three-quarter front view. Fig. 2. Three-quarter rear view. Fig. 3. Front view. Fig. 4. Radiator installation and attachment of engine support and center section struts. Fig. 5. Duralumin hull ready for mounting of wings and power plant. Fig. 6. One of the hull frames located ahead of step. Fig. 7. Close-up of the bow of the hull.

Gasoline System

The gasoline system consists of two 50 gal. tanks mounted in the center panel above the motor and of a 70 gal. reserve tank in the hull. This latter is used only in case of flights over 4 hr. duration, and ordinarily is separated by a valve from the rest of the gasoline system. The tanks are made of aluminum alloy sheets and all three of them weigh but 60 lb. for 170 gal. capacity. The piping between the tanks is 1 in. in diameter, while the individual lines to the carburetor are of ½ in. diameter.

The gravity feed from the main tanks to the carburetor is an assurance of reliability under all conditions.

So carefully was the installation made that in about 200 flights of the newly designed ship only two forced landings were encountered, one due to the clogging of carburetor jets, another due to a faulty ignition switch. In both cases the trouble was remedied without outside assistance and the trip was continued with but short delay.

The Metal Hull

The hull is by far the most interesting feature of the AMC flying boat. As it was already mentioned, the hull is built entirely of sheets of 17S alloy.

The framework of the hull consists of eighteen frames, five complete water-tight bulkheads and fore and aft stiffeners on deck and bottom. All the frames and stiffeners are made of the same size of U shaped sections, the thickness of metal varying from 1/32 to 1/16 in. according to the place where used. The U shaped sections were pressed out of flat sheet with flanges to which the covering was riveted on assembly. Thus, when the work was completed, no edges were left exposed, and the rounded back of the section was pleasing to the eye and practically immune to abrasion. Adherence to the same size of section greatly simplified the making of all joints between members, and incidentally saved lots of space in stock room. The bottom members of the frames (floors) are of box section, built up of two solid 17S alloy webs and channel top, all riveted together. Fig. 6 shows a typical frame in front of the step, at rear passengers' seat. In this case an additional cross member was required to support the seat, and from this member to the bottom the frame is covered with 17S alloy sheet forming a big storage space in the hull back of it.

The covering is of 3/64 in. thickness on sides and top of hull and of 1/ 16 in. thickness on bottom ahead of step. The covering is riveted to the frames and stiffeners with 17S alloy rivets. The chine, sponson clamp and deck clamp are made of 1/16 in. metal throughout and are riveted over the covering. The bottom of the boat is quite smooth and clean, all stiffeners or keelsons being placed inside where they are protected from damage in handling of boat. This feature certainly will be appreciated by those who want the boat to give long and faithful service without annoying and costly repairs.

To protect the bottom further, a heavy oak keel is provided. This keel is not a part of the structure, and can be quickly taken off and replaced when worn out. A strong metal keelson inside of boat is dependent solely to give required strength. Fig. 7 shows the bow of the hull, and gives a good idea of the keel as well as of all mooring and towing fittings. Anxious as the designers were to get a lighter and better performing boat, they always remembered that service is paramount and did not try to skim over any of the requirements derived from the practical commercial operation of Aeromarine flying boats.

Performance

When the AMC flying boat was given real service tests, it was found to be satisfactory in the air as well as on the water. The first satisfaction the Aeromarine designers got was during weighing of the hull, when it was found to be about 100 lb. lighter than the old wooden hull of the same displacement. The boat was launched on June 1, 1923, and was found to possess quick take-off and an unusual amount of zooming capacity and maneuverability. On the third day she was flown with company officials from Keyport to New York. Then the performance trials followed without the slightest mishap.

Up to the present time the boat was actually in the water more than three months, and made about 200 flights, totaling 70 hr. The log of the boat shows that more than 800 passengers were carried, exclusive of crew, and 4800 miles were flown. Not a drop of water was found in the wing tip pontoons, and only some rain water was found in the hull.

Book Reviews

VOM FLIEGEN (Flying) By Prof. Kurt Wegener. 104 pp., 17 figs. (R. Oldenbourg, Munich and Berlin.)

A most interesting little book written from the standpoint of the flier, who is not a technical man and wishes to avoid formulae yet is anxious to obtain a clear understanding of the many practical problems connected with flying. Written in a very elementary manner, entirely without mathematics or even difficult diagrams, the book is thoroughly sound and

Monument commemorating Germany's pioneers in gliding flight, erected on the summit of the Wasserkuppe, in the Rhoen hills

reliable. The author evidently understands the flier very well and sympathizes with him thoroughly. It is quite a pity that no English translation of this book is available.

The author classifies as fliers not those men who have hesitatingly piloted a machine a few times, but those who really love the art and feeling of flying. Some very pertinent remarks in this regard are followed by an interesting digression on the physiological aspects of flying, the dangers to health of too rapid a change in altitude, and the possibility of flying being engaged in for many years without the slightest danger to health.

In the rest of part I, on the "Art of Flying", very simple explanations are given of the action of the motor and propeller, correct landings and get-aways, and maneuvers in the air.

Part II is devoted to a description of the various instruments used on board an airplane, and Part III is an extremely simple and well written introduction to aerology.

HAWA NACHRICHTEN. Quarterly publication of the Hannoversche Waggonfabrik A. G., Hannover-Linden, Germany.

This house organ of the Hannover Waggon Works which during the late war produced several well known military airplanes for the German Air Force, recently issued a special gliding flight number containing interesting reading matter on the subject. Some excellent and hitherto unpublished photographs of German gliders and sketches of German glider pilots(Martens, Hentzen, Espenlaub, Blume and others) accompany the text.

AIRPORTS AND AIRWAYS

The Oldest Air Mail Flag

Proof that the air mail service dates back into the ancient civilization of China is afforded by the Chinese postal flag as now used by the Far Eastern nation.

The flag is unusual in design and history. With a flying goose as its central feature, this banner tells the story of the first air mail, which was a very early forerunner of the transcontinental air mail service of the U. S. Post Office Department.

According to students of the postal service there is a legend that geese were trained to fly between the provinces of ancient

The Chinese air mail flag—probably the oldest of its kind in existence

China, carrying messages attached to their legs. In this use they were the antecedents of even the homing pigeons of mediaeval times in Europe.

It is the belief of officials of the U. S. Post Office Department that these geese constituted the original air mail, the record of which is perpetuated by the noble bird appearing on the time-honored banner of the Chinese postal service.

The accompanying reproduction of the Chinese air mail flag is available through the courtesy of the Post Office Department.

Chicago News

Elmer Partridge is flying his new monoplane limousine regularly at Ashburn field. This ship was only recently completed and fully comes up to the expected performance. It is a three-place, all enclosed job with thick monoplane wing and powered with the old reliable OX5 motor.

John Huber, the 17 year old student of Lake View high school, who recently completed his instructions in his home built Canuck, has flown his ship to Black's field where he expects to keep it over the winter.

Richard Boetcher is overhauling his Laird Swallow, getting ready for a long winter.

Among other important points discussed at the meeting of Chicago members of the National Aeronautic Association at the Hamilton Club, Monday evening, Oct. 15, one point in particular was gone into thoroughly. This was to gain the friendship and cooperation of the Aero Club of Illinois and the Chicago Air Board. Neither of these organizations has so far recognized the N.A.A.

The Chicago chapter of the N.A.A., which now lacks only six or seven members in order to get its charter, has started out with lots of pep and is determined to keep up its activity, hoping to be openly recognized as Chicago's leading aeronautical organization in the very near future. Both the Aero Club and Air Board have accumulated a wealth of information, which the N.A.A. as newcomers in the field, have not got.

It is hoped that the non-commital feelings of the other organizations will soon be overcome and that they will join the national association, thus sharing their experience with the latters activity.

Most of the meeting was taken up by talks on the constitution and by-laws, which the Chicago delegates to St. Louis were especially asked to report on.

The landing field committee reported some good work done in securing the north end of Lincoln Park for a landing field. The committee had a conference with former Mayor Thompson who assured them his support. As the ex-mayor has great influence on the park commissioners, the battle seems half won.

The matter of publicity was discussed by Otto Klein, Chicago correspondent of AVIATION, who suggested that the daily papers be asked to have one or more of their aviation representatives join the association, give aviation more publicity and, what is most important, the right kind of publicity.

As mentioned before, the chapter is still shy a few members. Several of the members present, however, pledged themselves to bring in the required number of members so Chicago will have its charter before the next meeting. For the time being Dr. R. R. Ferguson will act as president, Terence Vincent as secretary and J. A. Colvin as treasurer. Permanent officers will be elected upon formation of the chapter.

Air Activities in Mexico

A contract providing for a passenger and freight service by airplane has been signed by the Mexican Minister of War with the representative of the Aerial Navigation Co. of Mexico. This company is said to be allied with the Air Navigation Co. of Colombia (SCADTA) which has been operating a mail and passenger service between Cartagena and Bogotà for the past two years.

The company hopes shortly to establish service between Vera Cruz and Progreso, using Junker machines and German pilots. The next route to be set up will be from Guadalajara to Mazatlan.

The Mexican press also reports that a passenger and freight seaplane service between the ports of Vera Cruz and Progreso, Yucatan, will be inaugurated during the month of December by a German company.

The proposed budget of the Mexican War Department for the year 1924 contains a rather large item for the purchase of new airplanes for the army air force. According to the press, it is planned to purchase a number of planes in Europe, but it is quite possible that American aircraft manufacturers will have a chance to furnish most of this equipment after this appropriation is available on Jan. 1, 1924. The Transportation Division of the Department of Commerce, Washington, D. C. has in its possession the name of the proper official to address in this matter.

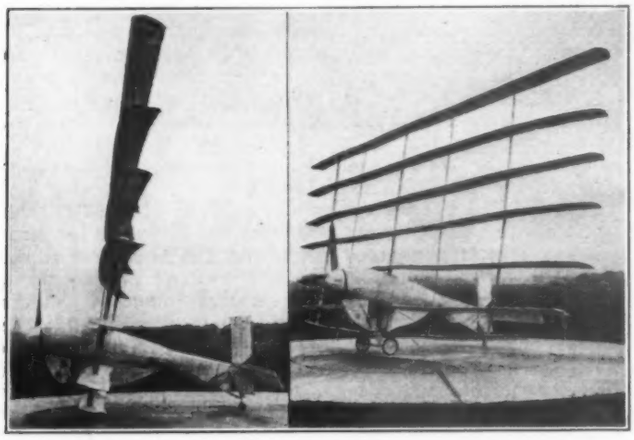
Sites for Schneider Cup Race, 1924

Several localities are already under consideration for next year's Schneider Cup race, among them Long Island Sound. While other sections of the country will no doubt dispute the fact, Long Island Sound offers an ideal course for the next Schneider Cup race. Its protected harbors are unsurpassed anywhere; facilities for rapid and convenient transportation on both sides of the sound by boat, train, automobile and airplane are unequalled; seaplane hangars are available and the principal airplane factories of the country are nearby. A triangular course is, however, impracticable. A straightaway course with adequate turns could be easily provided if the rules permit.

Details of the Gerhardt "Cycleplane"

The following interesting details are given by *Slipstream* of the "Cycleplane" developed by W. F. Gerhardt, aeronautical engineer at McCook Field, and E. L. Pratt, flight test observer, the trials of which were recently reported by AVIATION.

Since the primary motive for this initial test was to obtain calculations on the amount of thrust required to propel the craft forward, an attachment of the "Cycleplane" was made with an automobile by using a small wire, whereas the machine was towed forward at a moderate speed. At different periods the pilot operated the foot power mechanism while registrations of the variations in "pull" on the wire were caught by a



Two views of the "cycleplane" built by W. F. Gerhardt and E. L. Pratt at McCook Field, which actually left the ground

spring scale attached to the towing line. It was found that a forward thrust of approximately 24 lb. is required for a take-off after which this thrust is reduced to about 16 lb.

A sensation was created when the pilot was able to maintain himself in free flight for a considerable distance as evidenced by the slackened tow line, and the inventors now feel confident that their invention marks a great step forward in the development of man-powered aircraft.

The entire structural weight of the machine amounts to only 98 lb. It stands 19 ft. high, has an 18-in. chord and a 40-ft. wing span. The spars and leading edge of wings are constructed of balsa wood, the ribs and fairing are of reed, while the longerons and fuselage are spruce. The foot power mechanism was constructed from an ordinary bicycle with a gear drive arrangement to the propeller.

The designers admit that the "Cycleplane" in its present form is of frail construction and that the power apparatus does not produce the maximum efficiency of the propeller. The fact however, that the initial tests brought out such interesting facts concerning this new wing arrangement has led the designers to concentrate their efforts toward the construction of a perfected "Cycleplane."

St. Louis News

The St. Louis Flying Field is now a deserted place compared to the feverish activity of the race week. With the departure of the Barling Bomber the greatest part of the exhibit that attracted the crowds disappeared. The Bomber took off without difficulty at 1.15 Oct. 10, planning to fly direct to Wilbur Wright Field without stopping. Exhibitions over cities intervening, however, led Lt. H. R. Harris, A. S. pilot, to stop for the night at Chanute Field, Rantoul, Ill. The next morning, he took off again and reached his home station Thursday afternoon.

The RN1, the largest non-rigid airship in the United States, whose maiden flight took place during the races, on Oct. 6, is now undergoing a change of engines, two 300 hp. Packards, of a type similar to those on the Shenandoah, being installed. The RN1 is stationed at Scott Field, 26 mi. from St Louis.

Maj. John A. Paegelow, commanding Scott Field, and Lieut. William Farnum took the TC3, another non-rigid airship, to Kansas City, leaving St. Louis after the smoker given visiting aviators Saturday night, Oct. 7. They left at 2 a. m. Sunday morning, and reached Kansas City shortly after 6, being aided by a strong wind. The ship was the first dirigible to visit Kansas City. The return trip was also made by dark, and took over twelve hours, due to the strong head wind. The whole trip was made at the height of 1000 ft., and the ship behaved perfectly.

While final reports on the financial outcome of the International Air Meet are not yet issued, the managers report that it appears to be an even break. No great profit is expected, and there may even be a loss, although it is not expected to reach any appreciable figure.

Most of the civilian fliers have left the field. The results of the Sunday exhibition put on by the Flying Club of St. Louis were quite satisfactory to them. Each of the fliers received a fee for stunting for the crowd, and all were given a chance to take up passengers, nearly 1000 being carried without accident.

The Flying Club of St. Louis announced last week that they had purchased a plane for the use of members. The plane is a Canuck, and a new motor will be installed. The members using the plane will mutually insure it. As over 200 pilots are members of the club, five more planes will be purchased before the fleet is complete.

Flying into Canada

The Aeronautical Chamber of Commerce has received the following communication from the Department of State regarding airplane flights from the United States to Canada:

"Gentlemen:

"It has been brought to the attention of the Department of State that airplanes owned by private companies or persons have recently flown from the United States into Canada without complying with the Canadian regulations which, as you know, require that the permission of the Canadian Department of National Defence be first secured, and that the airplane be marked with a nationality and registration mark; also that the aircraft have a certificate of airworthiness issued either by the United States War Department or Navy Department, and that such aircraft land at a Canadian Customs airdrome.

"This Department is informed that the certificate of airworthiness called for may be secured upon application at any Army or Navy airdrome in this country.

"Your assistance in bringing the Canadian requirements to the attention of all companies or persons who are likely to attempt flights of commercial aircraft into Canada is earnestly requested so that there may be no more such unauthorized flights as have recently occurred.

"I am Gentlemen,

"Your obedient servant,

"For the Secretary of State:

"(signed) William Phillips, Under Secy."

Full particulars regarding the Canadian requirements will be furnished by the Department of State upon application.

(The statement that certificates of airworthiness for civil planes may be secured upon application at any Army or Navy airdrome is interesting news. So far neither the Army Air Service nor the Naval Aviation has made any official announcement to that effect.—EDITOR)

London-Prague Air Service

On Aug. 15, 1923 the London-Cologne air service of the Instone Air Line was extended to Prague. This service has been established by an official agreement between the British and Czechoslovakian governments.

Prague, which is 32 hr. from London by rail and steamer, may be reached in 8 hr. flying time with the new service, or, allowing for stops (including Brussels, Cologne, and Cheb—near Carlsbad and Marienbad—Czechoslovakian health resorts) in 10 hr. Leaving London at 9.45 a. m., the planes, making a flight of approximately six hundred miles, reach Prague at 7.45 p. m.

Patronage of the air routes out of Cologne is steadily increasing, and many Germans as well as American and English travellers now avail themselves of this means of transport.

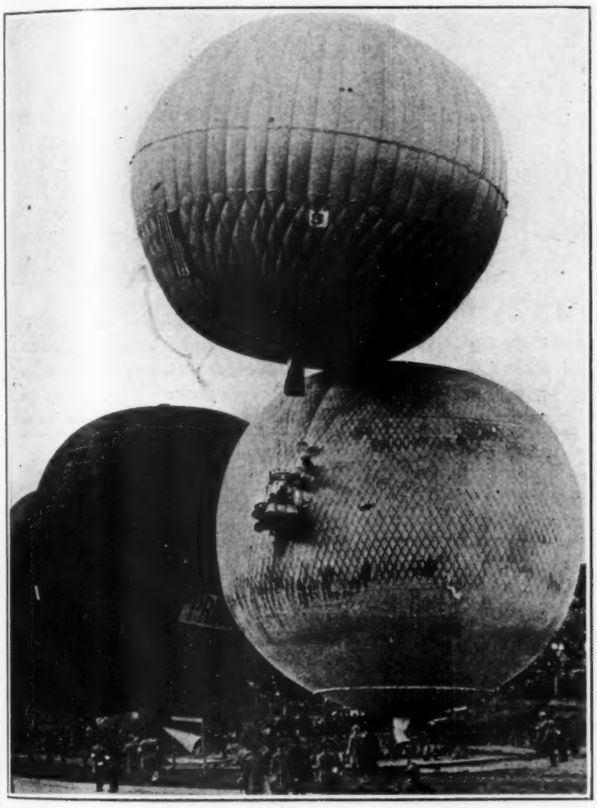
U. S. ARMY AND NAVY AIR FORCES

U. S. ARMY AIR SERVICE

Lieuts. Olmstead and Shoptaw

Owing to the pressure of business incident to the National Air Races at St. Louis, only a brief notice could be given in these columns to the accidental death of Lieut. Robert S. Olmstead and Lieut. John W. Shoptaw, pilot and aide of the Army balloon S6, in the Gordon Bennett race.

It will be remembered that before the S6 was struck by lightning and fell in flames killing its crew, the balloon had collided with the Belgian balloon "Ville-de-Bruxelles" at the time of taking off. The accompanying illustration which records



P. & A. Photo

How the U. S. Army balloon S6, Lieut. Olmstead, pilot, rammed the Belgian balloon Ville-de-Bruxelles at the start of the Gordon Bennett race in Brussels, Belgium, Sept. 23

this occurrence was probably the last photograph of the unfortunate balloon and its crew.

Lieutenant Olmstead, one of the most promising young officers of the Lighter-than-Air Division of the Army Air Service, was born on July 28, 1886, at Sheldon, Vt. Prior to his entry into the military service during the late war, his occupation was that of designing engineer for the Boston and Albany Railroad. He studied civil engineering at Tufts College, Franklin Union and Boston College. In September, 1917, he enlisted in the Aviation Section of the Signal Corps and was sent to the Army Balloon School, Fort Omaha, Neb., for instruction in ballooning. He was commissioned Second Lieutenant Jan. 9, 1918, and was assigned to duty with a balloon detachment at Fort Sill, Okla. In April he was sent back to Fort Omaha for duty as instructor in the Balloon School. He was promoted First Lieutenant Sept. 17, 1918. After a course of training in lighter-than-air work at Ross Field, Arcadia, Calif., he was transferred, in November, 1918, to Washington, D. C., for duty in the Training Division, Office Chief of Air Service. He later pursued a course of instruction in airship piloting at Langley Field, Va. and was rated as an Airship Pilot. Lieutenant Olmstead's last assignment was with the Industrial War Plans Division of the Air Service, with station at Middletown, Pa. He participated as an Army Air Service entrant in the International Balloon Race which started from Birmingham, Ala., in September, 1920, finishing sixth. With Lieutenant Shoptaw as his aide he won first place in the National Balloon Race, which started from Indianapolis, Ind., on July 4 last, his victory entitling him to compete for the James Gordon-Bennett Trophy in the International Balloon Race at Brussels, Belgium.

Lieutenant Shoptaw was born at Worthington, Ind., on March 28, 1889. He enlisted in the Signal Corps of the Regular Army in 1908, serving a three year enlistment. Thereafter and up to 1917 he was a member of Company A, Signal Corps, National Guard of Pennsylvania. During the war he was appointed a Master Signal Electrician in the Signal Corps, Regular Army, and was assigned to take a course of instruction at the Balloon School at Fort Omaha, Nebraska, upon completion of which, on Feb. 11, 1918, he was commissioned Second Lieutenant. On Aug. 13, 1918, he was promoted First Lieutenant. Due to his particular aptitude in all matters relating to the construction and rigging of balloons, most of his service during the war and for some time thereafter was at the factory of the Goodyear Tire and Rubber Co., Akron, Ohio. During the time the Army Air Service conducted an aerial patrol along the Mexican Border, Lieutenant Shoptaw was stationed at Camp Biernie, El Paso, Texas, in command of the 8th Airship Company. He had the distinction of piloting the first airship along the border. He was later assigned to take a course of instruction in lighter-than-air work at Ross Field, Arcadia, Calif., and was rated as Airship Pilot on Oct. 21, 1921. He was then transferred to Chanute Field, Rantoul, Ill., where he was in charge of instruction in the Lighter-than-Air course at the Air Service Technical School. He was rated as Balloon Observer on April 24, 1922.

Lieutenant Shoptaw has had over forty free balloon flights, his longest being 17 hr. 10 min. His total flying time in free balloons was 86 hr., in observation balloons 150 hr., in airships 120 hr. and in airplanes 100 hr.

Maj. Napier Killed in Crash

McCook Field was on Sept. 15, thrown into depression when it was learned that Maj. E. L. Napier, Flight Surgeon, Medical Corps, had been killed about 9.30 in the morning, when the Fokker D7, which he was flying, crashed to earth. Wing failure is thought to have caused the accident. Major Napier jumped for a parachute descent, but must have been struck on the head and made unconscious before clearing the spinning plane, as the rip cord had not been pulled.

Capt. John B. Powers accompanied the body to Major Napier's home, Union Springs, Ala., where the funeral services were held.

Considerable Flying at Kelly Field

Flying record for the Tenth School Group at Kelly Field, San Antonio, Texas, for the month of August is as follows: 1st week, 733 hr., 55 min.; 2nd week, 643 hr., 20 min.; 3rd week, 407 hr., 25 min.; 4th week, 286 hr., 15 min. Maximum hours in one day—150 hr.

Inclement weather made it necessary to discontinue flying for several days during the last week of August.

First Reserve Squadron Post Annual Dinner

The First Reserve Squadron Post of the American Legion, composed entirely of members of the Air Service who served overseas, held their annual dinner at Cavanaugh's on Oct. 9, over 125 members of the Post attending. The Commander of the Post, E. Garnsey Brownell, gave a short account of his recent trip abroad and his meeting with many former members of the Air Service now in business over there. Maj. Douglas B. Netherwood talked outlining the advantages to former Air Service officers of joining the reserve units being formed in the vicinity of New York.

At the regular meeting held before the dinner, a strong resolution was adopted to be sent to the National Headquarters of the American Legion, not only objecting to any reduction in the air forces of our Army and Navy, but calling upon the Legion officials to urge Congress to make our Air Service equal to any other great power.

The resolution which was unanimously adopted was as follows:

"Whereas it is the sentiment of the American Legion that the existence of a strong air force is essential to the proper protection of the United States, and

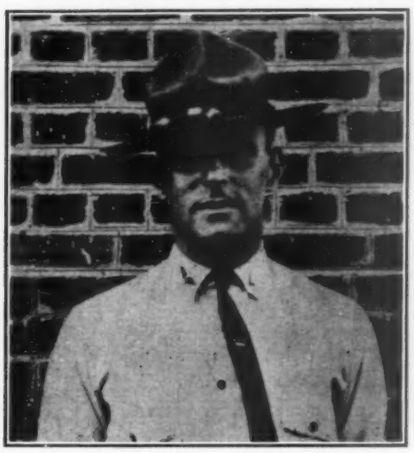
"Whereas, every other first class power except the United States is expending large sums of money in the enlargement of its aviation forces,

"Be it Resolved, that the American Legion do everything in its power to urge upon Congress that the United States be not inferior to any other nation in Air power, and that a copy of this resolution be forwarded to National Headquarters."

Facilitating Flying Operations at Kelly Field

The three operation huts now under construction at Kelly Field, San Antonio, Tex., are practically completed and will shortly be put in operation. Heretofore attempt has been made to carry on this work within the respective Group Headquarters buildings, with the Wing Operations Office in the building assigned the School, but due to the limited space therein it prevented the full functioning of same.

As all heavier-than-air students finish their training at this station, every effort is put forth to operate all departments along "model" lines. The operations huts when completed will function in a like manner. Complete equipment and map data will be available for all pilots who go on cross-country flights. A weather map, similar to the one now in use at Bolling Field, is believed will be one of the most complete "cross-country information bureaus" in the Air Service. The obtaining of landing field facilities is not being neglected, and every effort is being put forth to eventually obtain such data covering all towns of any size in this part of the Southwest.



Lieut. Harold L. George, A.S., winner of the Merchants' Exchange of St. Louis Trophy race for large capacity planes

Capt. Burt E. Skeel, A.S., winner of the 1923 Mitchell Trophy race for standard pursuit planes

Photos U. S. Army Air Service

Lieut. Clements McMullen, A.S., winner of the 1923 Liberty Engine Builders' Trophy race for 2-seater observation planes

Flying Statistics from Brooks Field

A new system has been installed in the flying office of the Primary Flying School at Brooks Field, San Antonio, Tex. This system shows the total of flying hours as the month progresses and also the totals of the previous months. The figures for August show that there were 969.55 aircraft hours, 1670.30 man hours, 187.10 aircraft cross-country hours, 365.35 man cross-country hours, or a total cross-country man miles of 30,278 and a total of 109,793 man miles for the field.

Gen. Mitchell Sails for Orient

Brig. Gen. William Mitchell, Assistant Chief of the Army Air Service, sailed on Oct. 2 on an extensive inspection trip in the Orient. He will look over the American Air Service in Hawaii, Guam and the Philippines, and later will visit Japan, China, Australia and the Straits Settlements.

Changes in Air Service Organizations in Hawaii

The organization of the 17th Composite Group was recently effected in accordance with General Orders of Headquarters, Hawaiian Department, and as then made up was comprised of the following:

Group Headquarters Detachment—4 officers and 9 enlisted men.

4th Observation Squadron: 6 officers and 119 enlisted men.

19th Pursuit Squadron: 5 officers and 124 enlisted men.

The 19th Pursuit Squadron was removed from inactive status and placed on active status. The former squadron insignia and colors were resumed and placed on its ships. Ships and material were loaned to the 19th Squadron by the 4th Squadron pending the arrival of its own equipment of MB3's. At the present time neither squadron is dependent upon the other in administration or operation.

New Home for 7th Photo Section

The 7th Photo Section, stationed at Wilbur Wright Field, Fairfield, Ohio, is now installed in a completely equipped series of rooms on the sunny side of the Headquarters Building, where the conditions are ideal for developing and printing. The photo section has recently made some excellent pictures of the Barling Bomber in flight and of the various racing planes which have been going through the try-outs at Wilbur Wright Field.

Army Orders

Orders First Lieut. James A. Healy, A. S., Scott Field, to Chanute Field, revoked.

One month's leave of absence to First Lieut. John A. Wyatt, A. S., effective Oct. 20, at termination of which Lieutenant Wyatt will sail for Hawaii.

Capt. William E. Lynd, A. S., Kelly Field, Tex., to A. S. Tactical School, Langley Field, for instruction, effective Oct. 10.

Maj. Delos C. Emmons, A. S., McCook Field, to Walter Reed General Hospital, Army Medical Center, Washington, D. C., for observation and treatment.

One month and eleven days' leave of absence, effective Oct. 16, to First Lieut. Walter K. Burgess, A. S., will sail for the Philippines, Dec. 6.

Capt. Richard H. Ballard, A. S., Langley Field, Va. to Post Field, Okla.

Orders First Lieut. Leo F. Post, A. S., to leave San Francisco Sept. 25, for Hawaii, amended directing Lieutenant Post to sail on transport from San Francisco Jan. 15, 1924.

Orders First Lieut. Robert V. Ignico, A. S., Aug. 21 amended as follows: Lieutenant Ignico, Air Intermediate Depot, Fairfield, Ohio, to A. S., Philippine Dept., Manila, P. I., transport sailing San Francisco Dec. 6.

Orders First Lieut. Charles M. Cummings, A. S., June 18, amended as follows: Lieutenant Cummings to leave San Francisco, transport sailing Nov. 20, for Hawaii.

Capt. Henry C. White, A. S., Scott Field, to Balloon and Airship School, Scott Field, for training.

Orders July 3 First Lieut. James F. Powell, A. S., amended as follows; Lieutenant Powell to Balloon and Airship School, Scott Field, effective Sept. 17.

One month and ten day's leave to First Lieut. Harry G. Montgomery, on completion of instruction at A. S. Balloon and Airship School.

First Lieut. Oliver Stevenson Ferson, A. S., promoted to Captain, effective Sept. 11.

Sec. Lieut. William S. Lawton, from A. S., Kelly Field, to Coast Arty. Corps, Fort Adams, R. I.

Orders First Lieut. Dudley E. Rowland, A. S., Mitchell Field to A. S., Panama Canal Dept., revoked.

First Lieut. James T. Curry, jr. A. S., Mitchel Field to A. S., Panama Canal Dept., C. Z., transport leaving New York City Nov. 28.

One month and fifteen days' leave, effective Oct. 1, to First Lieut. Courtland M. Brown, A. S., who will sail for Hawaii Nov. 20.

Orders Aug. 23 First Lieut. Dache M. Reeves, A. S., amended directing Lieut. Reeves to proceed from Scott Field to Chanute Field.

First Lieut. John W. Benton, A. S., from Panama Canal Dept. to Letterman General Hospital, San Francisco, for observation and treatment.

First Lieut. Melvin B. Asp, A. S., leave extended one month and fifteen days. Orders May 24 amended to read: Lieutenant Asp. A. S., Kelly Field and temp. duty Mitchell Field, to A. S., Panama Canal Dept., C. Z., on transport leaving New York City Nov. 28.

First Lieut. Edward M. Robbins, A. S., Langley Field, to A. S., Panama Canal Dept., C. Z., on transport leaving New York City Dec. 27.

First Lieut. Charles W. Sullivan, A. S., Fort Bliss, Tex., to A. S., Panama Canal Dept., C. Z., transport sailing San Francisco Nov. 1.

From Dayton to New York by Compass

A remarkable cross-country, non-stop flight was made by Lt. Albert F. Hegenberger, A. S. and Bradley Jones, navigation engineer at McCook Field, on Sept. 6 when the greater part of a journey from Dayton to Boston was made, completely out of sight of land and flying at an altitude of more than 10,000 ft.

Undaunted by reports of adverse weather conditions, Lieutenant Hegenberger and Mr. Jones took off at 10 a. m. A stock DH airplane was used, modified to carry large gasoline and oil tanks. A complete vertical instrument board, holding an air speed meter, a flight indicator, and earth inductor compass dial was placed in the front cockpit. The rear cockpit was especially fitted to facilitate the taking of sextant observations. It contained a magnetic compass, the control dial of the earth inductor compass and in the floor was a large drift sight.

The sky was filled with large cloud patches, which increased as they flew eastward. By means of a new type of drift meter, the drift to the north by a cross wind was measured and the compass course rectified accordingly. After forty minutes of flying the stadium of Ohio State University at Columbus was sighted to the south of the course. Then the clouds becoming quite dense, the plane ascended above them. A brief glimpse of the Ohio River at Beavertown gave assurance that the course was being correctly followed, then the blanket of clouds again hid the ground.

The lower layer of clouds stretched from 300 to 7000 ft. altitude. The plane climbed above this storm only to encounter another strata of clouds at 9,000 ft. Climbing through this, the flyers found themselves in clear sunlight a little above 10,000 ft. A solid wall of clouds stretched beneath them. Not a glimpse of a landmark was obtained thereafter for several hours. The entire state of Pennsylvania was passed over. At 3:40 p. m. Lieutenant Hegenberger estimated that he should be close to the Hudson River, so he descended through the clouds and the Hudson was crossed not five minutes later. From the Ohio to the Hudson River, the trip had been made without sight of the earth. The flight was continued under the clouds, passing over Hartford, Connecticut, which was recognized and was the first check on the course after 400 mi. of travel. As Hartford is but a few miles off the direct course, the flyers were delighted with the results of their experiment. The new airport at Boston was reached without incident and a landing accomplished at 6:25 p. m. daylight saving time, making the time consumed by the flight 7 hr. 25 min. But a small ration of gasoline remained in the tank. The latest model of earth inductor compass was used to steer by, and it functioned perfectly. The purpose of the trip was the testing of these instruments.

Lieutenant Hegenberger, who has been in charge of the Instrument Branch at McCook Field, is one of the foremost exponents of the use of navigation instruments in flying and, as an example of such use, this flight is looked upon as a remarkable achievement.

U. S. NAVAL AVIATION

Orders to Officers

Lt. Comdr. Eric L. Barr, detached Submarine Base, San Pedro, to Naval Air Station, San Diego, Calif.

Lt. Comdr. Robert S. Chew, (SC) detached Naval Station, Guantanamo Bay, Cuba, to Naval Aircraft Factory, Phila.

Comdr. Jacob H. Klein, detached all duty, to U.S.S. Shenandoah.

Lt. Comdr. Joseph M. Deem, detached all duty, to U.S.S. Shenandoah.

Lt. Comdr. Joseph P. Norfleet, detached all duty, to U.S.S. Shenandoah.

Lt. Clifford A. F. Sprague, detached Aircraft Squadrons Scouting Fleet, to Naval Aircraft Factory, Phila.

Lt. Earl H. Kincaid, detached all duty, to U.S.S. Shenandoah.

Lt. Roman J. Miller, detached all duty, to U.S.S. Shenandoah.

Lt. Charles E. Rosendahl, detached all duty, to U.S.S. Shenandoah.

Lt. Raymond F. Tyler, detached all duty, to U.S.S. Shenandoah.

Lt. William C. Colbert, detached Naval Aircraft Factory, Phila. to Navy Yard, Phila.

Ens. Edgar W. Sheppard, detached all duty, to U.S.S. Shenandoah.

Pay Clk. Clarence B. Archer, detached Navy Yard Phila., to U.S.S. Wright.

Pay Clk. Harry S. MacKan, detached U.S.S. Wright, to Navy Yard, Charleston, S. C.

Lieut. Radford Leaves Bureau

Lieut. Arthur H. Radford, U.S.N., of the Bureau of Aeronautics, has been assigned to the Aircraft Squadrons Battle Fleet, and left Washington for his new duty on Oct. 6. Lieutenant Radford was on duty in the Bureau of Aeronautics for over two years. He will be greatly missed.

New Naval Aviation Reserve Unit

Secretary Denby has authorized the creation of a Naval Aviation Reserve unit at Chicago, Ill., which will centralize all Naval Aviation Reserve activities for the 9th Naval District embracing thirteen states of the Middle West.

The reserve aviation activities will center around the Great Lakes training station, which during the war was a rallying point for Naval recruits throughout the Middle West. Facilities for the upkeep, repair and operation of naval aircraft already exist at the Great Lakes Station and will be made full use of in the activities which are about to be initiated. This is the third reserve aviation unit to be inaugurated and is in line with a plan to build up a naval aviation reserve throughout the country as funds become available. Two other units already in commission are located at Fort Hamilton, N. Y., and Boston, Mass.

The activities of the 9th district naval aviation reserve unit will be under the direction of the Commandant of the district in Chicago and will be directly supervised by an officer pilot who will be designated by the Bureau of Aeronautics of the Navy Department to assist the Commandant. A ground school will be started as soon as aeronautical equipment is received though practical flying may not commence until the spring.

The reserve unit which will be established in Chicago will be a rallying point for naval aviators who were in service during the war and will afford an opportunity to the youth of the Middle West to learn aeronautics and to qualify as naval reserve aviators.

Plans for Future of ZR1 and ZR3

Plans for future operation of the Shenandoah and her German-built consort, ZR3, are still tentative, Naval officials in Washington declare. A proposal that the Shenandoah be sent to Panama with the fleet for Spring maneuvers has been discussed by Secretary Denby and his advisors. It is considered probable the flight will be attempted if necessary facilities will have been provided in time. These include construction of mooring masts at Cuba and Panama.

Utilization of the ZR3 is even less definite, it was declared officially. Under the terms of the Versailles treaty which authorized her building, the German ship must be used exclusively in commerce. Her use in the attempt to accelerate the transatlantic mails has been considered among other potential activities but no program has been laid out in advance of the showing of the airship on her test flights and on the voyage from Germany to America.

Owing to technical difficulties encountered in the perfection of the new Maybach engines and other natural difficulties of a non-technical nature the Zeppelin Co. does not expect to complete the ZR3 before the early part of 1924. Due to the above arrangements and on account of the unfavorable weather conditions often encountered in Germany in winter, the company has decided to postpone the trial of this airship until the early part of the Spring of 1924.

Army and Navy Pilots Cooperate

Two instances of the friendly spirit of camaraderie and cooperation that exists between the pilots of the Navy and Army air services occurred at Pearl Harbor, Hawaii, during the stay there this summer of units of the Aircraft Squadrons Battle Fleet. The Navy and Army air stations adjoin each other on Ford Island. A plane from Observation Squadron Two, from the Pacific Fleet, got into trouble and an Army Martin Bomber brought the parts of the damaged plane back to the station. In the other instance an Army JN6 was wrecked on the shore. Navy pilots brought the Army aviators back to their base.

Coco Solo to Venezuela

Two F5L's from the Naval Air Station at Coco Solo, Canal Zone, made a flight from there to La Guarra, Venezuela, and return during August and September. The two planes left Coco Solo on Aug. 11, and returned there on Sept. 5. The distance flown was about 2000 mi. Eight towns were stopped at besides numerous landings at points that looked interesting. The two planes were in the air during the trip for a total flying time of 78 hr. 22 min.

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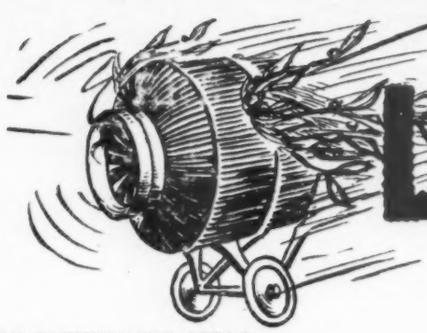

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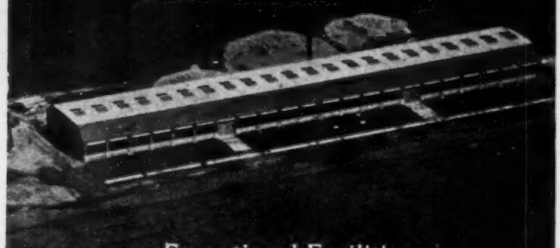

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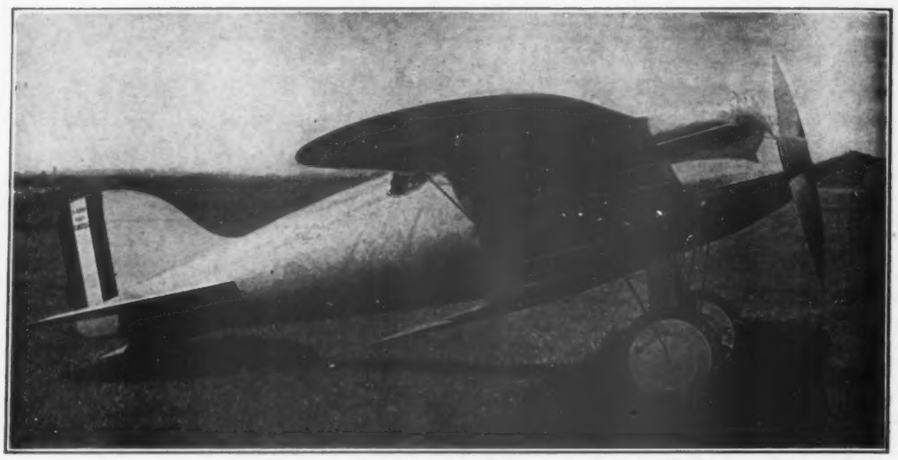

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